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GSO 216 (1994) (English): INDUSTRIAL SAFETY AND
HEALTH REGULATIONS EQUIPMENT: ELEVATORS



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STANDARDIZATION ORGANIZATION FOR G.C.C (GSO)



GSO 216/1994

**اشتراطات السلامة والصحة الصناعية -
الأجهزة - المصاعد**

**INDUSTRIAL SAFETY AND HEALTH
REGULATIONS
EQUIPMENT: ELEVATORS**

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INDUSTRIAL SAFETY AND HEALTH REGULATIONS EQUIPMENT: ELEVATORS

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**INDUSTRIAL SAFETY AND HEALTH
REGULATIONS
EQUIPMENT: ELEVATORS**

1. SCOPE AND FIELD OF APPLICATION

This standard is concerned with industrial safety and health regulations - equipment : elevators.

2. COMPLEMENTARY REFERENCE

- 2.1 GSO 1580/2002 “Industrial Safety and Health Regulations - Part 1: List of Contents”.

3. DEFINITIONS

- 3.1 Approved Device. An approved device is one on which a written approval for use has been issued by the concerned authority.
- 3.2 Buffer. A device designed to stop a descending car or counterweight beyond its normal limit of travel by storing or by absorbing and dissipating the kinetic energy of the car or counterweight.
- 3.3 Elevator
- 3.3.1 A hoisting and lowering mechanism which moves a car or platform in fixed guides in a substantially vertical direction and which is designed to carry passengers or freight, or both, between 2 or more fixed landings.
- 3.3.2 A hoisting mechanism such as a portable hoist or a tiering machine, used to elevate or to lower material between 2 or more fixed landings and used or fixed in a permanent location is classed as an elevator.
- 3.3.3 A hydraulic hoisting mechanism used to elevate or to lower material between 2 or more fixed landings and used or fixed in a permanent location will be classed as an elevator.
- 3.4 Emergency Stop Switch. A device located in the car which, when manually operated, causes the electric power to be removed from the driving machine motor and brake of an electric elevator or from the electrically operated valves and pump motor of a hydraulic elevator.
- 3.5 Governor. An attachment to an elevator for automatic control or limitation of speed.
- 3.6 Identification and Classification of Types of Safety Devices. Car safety devices are identified and classified on the basis of performance characteristics after the safety device begins to apply pressure on the guide rails. On this basis, there are three types of safety devices.

- 3.7 Type A Safety Devices. Develop a rapidly increasing pressure on the guide rails during the stopping interval, the stopping distance being very short due to the inherent design of the safety device. The operating force is derived entirely from the mass and the motion of the car or the counterweight being stopped. These safety devices apply pressure on the guide rails through eccentrics, rollers, or similar devices, without any flexible medium purposely introduced to limit the retarding force and increase the stopping distance.
- 3.8 Type B Safety Devices. Apply limited pressure on the guide rails during the stopping interval, and which provide stopping distances that are related to the mass being stopped and the speed at which application of the safety is initiated.
- Retarding forces are reasonably uniform after the safety device is fully applied. Continuous tension in the governor rope may or may not be required to operate the safety device during the entire stopping interval. Minimum and maximum distances are specified on the basis of governor tripping speed.
- 3.9 Type C Safety Devices (Type A With Oil Buffers). Develop retarding forces during the compression stroke of 1 or more oil buffers interposed between the lower members of the car frame and a governor-operated Type A auxiliary safety device plank applied on the guide rails. The stopping distance is equal to the effective stroke of the buffers.
- 3.10 Major Alteration is defined as changes in any of the following:
- Increase in rated speed.
 - Increase in rated load.
 - Increase in dead weight of the car of more than 5 percent.
 - Increase or decrease in height or rise.
 - Change in type of operation or control.
 - Change from freight to passenger service.
- 3.11 Oil Buffer. A buffer using oil as a medium which absorbs and dissipates the kinetic energy of the descending car or counterweight.
- 3.12 Oil Buffer Stroke. The oil-displacing movement of the buffer plunger or piston.
- 3.13 Safety Device, Car or Counterweight. A mechanical device attached to the car frame or to an auxiliary frame, or to the counterweight frame, to stop and hold the car or counterweight in case of predetermined overspeed or free fall, or if the hoisting ropes slacken.
- 3.14 Spring Buffer. A buffer which stores in a spring the kinetic energy of the descending car or counterweight.
- 3.15 Spring Buffer Load Rating. The load required to compress the spring an amount equal to its stroke.
- 3.16 Spring Buffer Stroke. The distance that the contact end of the spring can move under a compressive load until all coils are essentially in contact.
- 3.17 Terminal Stopping Device, Emergency. A device which automatically cause the power to be removed from the electric elevator driving-machine, at a

predetermined distance from the terminal landing, and independently of the functioning of the operating device and normal terminal stopping device, if the normal terminal stopping device does not slow down the cars as intended.

4. REGULATIONS

4.1 Elevators

4.1.1 Hoistways and Machine Rooms

4.1.1.1 The hoistway enclosure shall be constructed of building, ceiling and fireproofing materials conforming to good engineering practice.

4.1.1.2 Enclosures shall be building walls, solid fixed partitions, metal grating, wood, or grillwork. Where grillwork is used, the wire shall be not less than 3.4 mm diameter steel wire.

4.1.1.3 The openings in grillwork or between vertical boards shall reject a 50 mm ball. Vertical slots exceeding 25 mm in width shall not exceed 610 mm in length.

4.1.1.4 The openings in the grillwork or between vertical boards or bars shall not exceed 13 mm in width or length when moving parts within the hoistway, including sliding doors, are closer than 100 mm from the outside face of the enclosure.

4.1.1.5 Equipment in Machine Rooms of Power Elevators

4.1.1.5.1 Elevator machine and control equipment located at the top of the hoistway may be located in a room or space containing other machinery and equipment essential to the operation of the building, provided that they are separated from the other machinery or equipment by a substantial metal grille enclosure not less than 1.8 m high with a door or gate. The grille enclosure shall be of a design which will reject a ball 50 mm in diameter.

4.1.1.5.2 Elevated machine or control areas within an equipment room shall have a wall or enclosure, including access means, that provides a barrier not less than 1.8 m high above the adjacent floor.

4.1.1.5.3 Where the elevator machine and control equipment are not located at the top of the hoistway, a separate machine room shall be provided and only machinery and equipment required for the operation of the elevator shall be permitted in the elevator machine room.

4.1.1.5.4 The enclosure for the elevator equipment shall be arranged so that through the machine room or enclosure is not necessary to gain access to other equipment or other parts of the building.

4.1.1.6 Access to Machine Rooms and Machinery Spaces. Permanent means for safe and convenient access shall be provided to all machinery rooms, overhead sheave spaces provided with a floor, and secondary levels. This access shall be independent of the hoistway or car.

- 4.1.1.6.1 Where passage over roofs is necessary to reach the means of access to machine rooms or machinery spaces, the following requirements shall be conformed to.
 - 4.1.1.6.1.1 A stairway shall be provided from the top floor of the building to the exit door at the roof level.
 - 4.1.1.6.1.2 Where the passage is over a sloping roof having a slope exceeding 15 degrees from the horizontal an unobstructed, permanent, and substantial walkway not less than 60 cm wide, equipped on at least one side with a standard railing, shall be provided from the building exit door at the roof level to the means of access to the machine room or machinery spaces.
- 4.1.1.7 Access Doors. Elevator machine rooms or enclosures shall be secured against unauthorized access. Access doors shall be provided for all elevator machine rooms or enclosures.
- 4.1.1.8 Installation of pipes and ducts in hoistways, machine rooms, or machinery spaces. Pipes or ducts conveying gases, vapors, or liquids, and not used in connection with the operation of the elevator, shall not be installed in any hoistway, machine room, or machinery space.

Exceptions:

 - 4.1.1.8.1 Steam and hot water pipes may be installed in hoistways, machine rooms, or machinery spaces for the purpose of heating these areas only, subject to the following:
 - 4.1.1.8.1.1 Heating pipes shall convey only low-pressure steam (.35 kg/sq cm or less) or hot water (100°C or less).
 - 4.1.1.8.1.2 All risers and return pipes shall be located outside the hoistway.
 - 4.1.1.8.1.3 Traps and shut-off valves shall be provided in accessible locations outside the hoistway.
 - 4.1.1.8.2 Ducts for heating, cooling, ventilating, and venting may be installed in the machine room, subject to the following:
 - 4.1.1.8.2.1 Clear headroom of 2.1 m is maintained.
 - 4.1.1.8.2.2 Clear work space around all elevator equipment is maintained.
 - 4.1.1.8.2.3 No inspection covers, adjustable dampers or louvers, or cleanouts are installed in the elevator machine room.
 - 4.1.1.8.3 Pipes for sprinklers only may be installed in these spaces subject to the following:
 - 4.1.1.8.3.1 All risers and returns shall be located outside these spaces.
 - 4.1.1.8.3.2 Branch lines in the hoistway shall supply sprinklers at not more than 1 floor level.
 - 4.1.1.8.3.3 Shut-off valves shall be provided at accessible location outside these spaces.
 - 4.1.1.8.3.4 Sprinkler heads shall be guarded against accidental contact.
 - 4.1.1.8.4 Piping and wiring for elevator pit sump pumps may be installed in the hoistway.
- 4.1.1.9 Access to Pits. Safe and convenient access shall be provided to all pits.

- 4.1.1.10 Minimum Size of Hoistway Entrances. The clear opening provided by elevator entrances shall be not less than 2 m high nor less than 76 cm wide.
- 4.1.2 Car Enclosures. All elevator cars shall be permanently enclosed on all sides and the top, except that portion which is used as an entrance or entrances.
 - 4.1.2.1 Car Door and Gates
 - 4.1.2.1.1 A door or gate shall be provided at each entrance to the car.
 - 4.1.2.1.2 Car doors or gates shall be arranged so that when the car is stopped, they may be opened by hand from inside the car.
 - 4.1.2.1.3 Doors and gates, when in the fully closed position, shall protect the full width and height of the car entrance opening.
 - 4.1.3 Car and Counterweight Safety Devices
 - 4.1.3.1 Where Required and Located. The car of every elevator suspended by wire ropes shall be provided with one or more approved car safety devices of a type identified in item 3. The safety devices shall be attached to the car frame, and one safety device shall be located within or below the lower members of the car frame (safety plank).
 - 4.1.3.2 Duplex Safety Devices
 - 4.1.3.2.1 Where two (duplex) safety devices are provided, the lower safety device shall be capable of developing not less than 1/2 of the force required to stop the entire car with rated load. Duplexed safety devices shall be arranged so as to function simultaneously.
 - 4.1.3.2.2 Type A or Type C safety devices shall not be used in multiple (duplexed).
 - 4.1.3.3 Function and Stopping Distance of Safety Devices
 - 4.1.3.3.1 The safety device, or the combined safety devices where furnished, shall be capable of stopping and sustaining the entire car with its rated load from governor tripping speed. The weight of the entire car shall include any compensating ropes, traveling cables, and any other attachments to the car.

Exception: Safety devices of elevators equipped with alternating current driving machines may have the full load test conducted at normal down speed by tripping the governor by hand. item 4.1.4.2.1.2 for governor test required.
 - 4.1.3.3.2 Type B safety devices shall stop the car with its rated load from governor tripping speed.
 - 4.1.3.3.2.1 Table 1 shows the maximum and minimum stop ping distances for various governor tripping speeds for reference.
 - 4.1.3.3.2.2 The distance the car traveled, after the safety device began to engage the rails until the car stopped, shall be measured by taking the average of the four rail marks and deducting the length of the safety jaw or wedge.
 - 4.1.3.4 Counter Weight Safety Devices. Where any space below the hoistway is used for a passageway or is occupied by persons, or if unoccupied is not permanently sealed against access, elevator counterweights shall be provided with safety

devices conforming to the requirements for car safety devices with the following exceptions:

- Where otherwise specified in item 3, counterweight safety devices may differ from car safety devices.
- For rated speeds of not over 46 m/min, counterweight safety devices may be operated as a result of the breaking or slackening of the hoisting ropes and may be of the inertia or other approved type without governors.
- Every safety device actuated by the slackening or breaking of the hoisting cables shall be drop-tested when installed. This test shall be witnessed by a representative of the concerned authorities.
- Existing counterweights equipped with safety devices actuated by the breaking or slackening of the counterweight ropes and which have a rated speed of not more than 76 m/min.
- Wedge clamp safety devices shall not be used for counterweight safety devices unless they are arranged to be reset from the pit or the machine room.

4.1.3.5 Safety Devices to Stop Ascending Cars or Counterweights Prohibited. Safety devices shall not stop an ascending car or counterweight.

4.1.3.6 Governor Actuated Safety Devices and Car Safety Mechanism Switches Required. Car safety devices and counterweight safety devices, where provided, shall be actuated by separate approved governors with the following exceptions:

- Speed governors are not required for the operation of counterweight safety devices of elevators having a rated speed of not more than 46 m/min.
- Car safety devices shall be provided with a switch, operated by the car safety mechanism when the safety device is applied.

4.1.3.7 Limits of Use of Various Types of Safety Devices

4.1.3.7.1 Type A (instantaneous) safety devices may be used on elevators having a rated speed of not more than 46 m/min. When overspeed occurs, with the hoisting ropes intact, such safety devices shall be actuated by the governor.

On the parting of the hoisting ropes (free fall). Type A governor-operated safety devices shall apply without appreciable delay; and their application shall be independent of the speed action of the governor and of the location of the break in the hoisting ropes (inertia application) and may be accomplished by the use of a governor and governor rigging having a sufficiently high value of inertia to apply the safety device on free fall independently of the speed action of the governor.

4.1.3.7.2 Type C (combination instantaneous and oil buffer safety devices) may be used subject to the following requirements:

4.1.3.7.2.1 The rated speed shall be not more than 152 m/min.

4.1.3.7.2.2 The oil buffers stroke shall be based on governor tripping speed and on an average retardation not exceeding 9.8 m/sec.

4.1.3.7.2.3 After the buffer stroke has been completed, provision shall be made for an additional travel of plunger or piston of not less than 10 percent of the buffer

stroke to prevent excessive impact on the buffer parts and the auxiliary safety plank.

- 4.1.3.7.2.4 Where the distance between guide rails exceeds 2.4 m, the safety device shall be provided with two oil buffers of identical calibration; and the buffers shall be so located as to develop minimum stresses in the auxiliary safety plank during safety operation. Buffers shall be located in line with and symmetrically between the guide rails.

Table 1

**Maximum and Minimum Stopping Distances Type B Car Safety Devices
With Rated Load, and of Type B Counterweight Safety Devices**

Rated Speed m/min	Maximum Governor Trip Speed m/min	Stopping Distances	
		Minimum	Maximum
0 to 38	53	25 mm	381 mm
46	64	50 mm	406 mm
53	76	75 mm	483 mm
61	85	100 mm	508 mm
69	94	127 mm	610 mm
76	103	152 mm	686 mm
91	120	203 mm	838 mm
107	138	254 mm	965 mm
122	155	279 mm	1.2 m
137	173	432 mm	1.5 m
152	191	457 mm	1.7 m
183	226	711 mm	2.3 m
213	261	965 mm	3 m
244	296	1.2 m	3.8 m
274	331	1.5 m	4.6 m
305	366	1.9 m	5.6 m
335	402	2.3 m	6.8 m
366	439	2.7 m	8 m
396	475	3.2 m	9.4 m
427	512	3.7 m	10.8 m
457	549	4.3 m	12.4 m

- 4.1.3.7.2.5 The rail-gripping device of the auxiliary safety plank shall be so arranged and connected as to prevent the plank from being cut of level more than 13 mm in the length of the plank when the safety device is operated to stop the car.

- 4.1.3.7.2.6 An electric switch shall be provided and so arranged and connected that the elevator cannot be operated by means of the normal operating device if any buffer is compressed more than 10 percent of its stroke.

- 4.1.3.7.2.7 Means shall be provided to prevent operation of the elevator by the normal operating device if the oil level in any buffer is below the minimum allowable level.

- 4.1.3.7.3 No car-holding safety device shall be used for a greater total load or speed than that specified in the approval. The weight of the independent car counterweights, where used, may be deducted from the total load of the car and capacity in determining the load on the safety device.

- 4.1.3.8 Application and Release of Safety Device
- 4.1.3.8.1 Safety devices shall be applied mechanically. Electric, hydraulic, or pneumatic devices shall not be used to apply the safety devices required by this item nor to hold such safety devices in the retracted position.
- 4.1.3.8.2 The application of the safety device to stop the car, with its rated load centered on each quarter of the platform symmetrically with relation to the center lines of the platform, shall not cause the platform to be out of level more than 10 mm in any direction except when Type C safety devices are used.
- 4.1.3.8.3 When car safety devices are applied, no decrease in tension in the governor rope motion of the car in the down direction shall release the safety devices, but such safety devices may be released by the motion of the car in the up direction.
- 4.1.3.8.4 Safety devices shall be so designed that on their application the forces which provide the stopping action shall be compressive forces on each side of the guide rail section.
- 4.1.3.9 Minimum Permissible Clearance Between Rail Gripping Faces of Safety Device Parts. In the normally retracted position of the safety device, the distance between the rail-gripping faces of the safety device parts shall be not less than the thickness of the guide rail plus 3.5 mm; and the minimum clearance on any side between the gripping face and the guide rail shall be not less than 1.6 mm as measured on the side of the rail toward which the car frame is pressed with sufficient force to take up all clearances in the guide shoe assembly. Safety device jaws, while in the retracted position, shall be so restrained as to prevent a reduction of this minimum clearance.
- 4.1.3.10 Maximum Permissible Movement of Governor Rope to Operate the Safety Device Mechanism
- 4.1.3.10.1 For all drum-operated safety devices, the movement of the governor rope, relative to the car, required to operate the safety device mechanism from its fully retracted position to a position where the safety device jaws begin to exert pressure against the guide rails, shall not exceed the following values based on rated speed:
- | | |
|-------------------|-------|
| 61 m/min. or less | 1.1 m |
| 61.1 m/min. | 91 cm |
| Over 114 m/min. | 76 cm |
- 4.1.3.10.2 Drum-operated car safety devices, requiring continual unwinding of the safety device drum rope to fully apply the safety device, shall be so designed that not less than three turns of the safety device rope will remain on the drum after the overspeed test of the safety device has been made with rated load in the car.
- 4.1.3.11 Bearing in Safety Devices and Safety Devices Operating Mechanisms. Bearings shall be of corrosion-resistant construction with one or both members of a bearing made of, or electroplated with, a corrosion-resistant material.
- 4.1.3.12 Marking Plate for Safety Devices. A metal plate or plates shall be securely attached to each safety device so as to be readily visible, and shall be marked in a legible and permanent manner with letters and figures not less than 6 mm in height indicating the following:

The type of safety device.

The maximum tripping speed in m/min. for which the safety device is designed to be used.

The maximum weight in kilograms for which the safety device is designed to be used with the car frame in which it is installed.

The name of the manufacturer and the identifying number of the safety device.

- 4.1.3.13 Governor Rope Releasing Carriers. The governor-rope releasing carrier on the car (or on the counterweight) shall be set to require a tension in the governor rope, to pull the rope from the carrier, of not more than 60 percent of the pull-through, tension developed by the governor; and the carrier shall be designed so that the pull-out tension cannot be adjusted in a normal manner to exceed the amount specified. Tension in the governor rope required to pull the rope from the carrier shall not exceed 136 kg.
- 4.1.3.14 Rail Lubricants and Lubrication Plate. Rail lubricants or coatings which will reduce the holding power of the safety device or prevent its functioning as required in item 4.1.3.3 shall not be used.
- Where lubricants are to be used, a metal plate shall be securely attached to the car crosshead in an easily visible location, and shall carry the notation “CONSULT MANUFACTURER OF THE SAFETY DEVICE FOR THE CHARACTERISTICS OF THE RAIL LUBRICANT TO BE USED”.
 - If lubricants other than those recommended by the manufacturer are used, a test shall be made to demonstrate that the safety device will function as required, by item 4.1.3.3.
- 4.1.3.15 Compensating Rope Tie Down. For rated speed of 224 m/min. or more, a device shall be provided to tie the car, and counterweight together to limit the jump of the car or counterweight as a result of buffer engagement of application of car or counterweight safety device.
- 4.1.4 Governors
- 4.1.4.1 Governors Required. Every elevator and every counterweight equipped with an approved type, governor-actuated safety device shall be equipped with an approved governor.
- 4.1.4.2 Tripping Speeds for Governors
- 4.1.4.2.1 Governors for car safety devices shall be set to trip at overspeeds as follows:
- 4.1.4.2.1.1 At not less than 115 percent of rated speed.
- 4.1.4.2.1.2 At not more than the tripping speed listed opposite the applicable rated speed in Table 2. For rated speeds exceeding 475 m/min., the maximum tripping speeds shall not exceed 120 percent of the rated speed.

Table 2

**Maximum Speeds In Meters/Minute at Which
Governor Trips and Governor Overspeed Switch Operates**

Rated speed m/min	Governor Maximum trip speed	Maximum speed at which governor overspeed switch operate, down
0 – 33	53	53*
46	64	64*
53	76	69
61	85	77
69	94	84
76	103	92
91	120	108
107	138	124
122	155	140
137	173	156
152	191	172
183	226	214
213	261	247
244	296	281
274	331	314
305	366	347
335	402	382
366	430	417
396	475	452
427	512	486
457	549	521

* Governor Overspeed Switch Not Required on Car Governors

- 4.1.4.2.2 Governors for counterweight safety devices shall be set to trip at an overspeed greater than, but not more than 10 percent above, that at which the car governor is set to trip.
- 4.1.4.3 Scaling and Painting of Governors. Governors shall have their means of speed adjustment scaled after test. If governors are painted after sealing, all bearing and rubbing surfaces shall be kept free of paint and a hand test made to determine that all parts operate freely as intended. Seals shall be of a type which will prevent readjustment of the governor tripping speed without breaking the seal. Whenever this seal is broken, the governor shall be rechecked and set for the proper tripping speed.
- 4.1.4.4 Governor Overspeed and Car Safety Device Mechanism Switches
- 4.1.4.4.1 A switch shall be provided on the governor, and operated by the overspeed action of the governor when used with Type B and C car safety devices of elevators having a rated speed exceeding 46 m/min. A switch shall be provided on the governor when used with counterweight safety devices at any car speed.

- 4.1.4.4.2 Every car safety device shall be provided with a switch operated by the car safety device mechanism when the safety device is applied.
- 4.1.4.4.3 The switches shall, when operated, remove power from the driving-machine motor and brake before or at the time of application of the safety device.
- 4.1.4.4.4 The setting of the car governor overspeed switch shall conform to the following:
 - 4.1.4.4.4.1 For rated speeds more than 46 m/min. up to and including 152 m/min., the car governor overspeed switch shall open in the down direction of the elevator at not more than 90 percent of the speed at which the governor is set to trip in the down direction.
 - 4.1.4.4.4.2 For rated speeds more than 152 m/min., the car governor overspeed switch shall open in the down direction of the elevator at not more than 95 percent of the speed at which the governor is set to trip in the down direction.
 - 4.1.4.4.4.3 The governor overspeed switch, when set as specified in either item 4.1.4.4.1 or item 4.1.4.2.2 shall open in the up direction at not more than 100 percent of the speed at which the governor is set to trip in the down direction.
 - 4.1.4.4.4.3.1 The governor overspeed switch may be set to open in the down direction of the elevator at not more than 100 percent of the speed at which the governor is set to trip in the down direction, subject to the following requirements:
 - A speed-reducing switch is provided on the governor which will reduce the speed of the elevator in case of overspeed, and which shall be set to open as specified.
 - Subsequent to the first stop of the car following the opening of the speed-reducing switch, the car shall remain inoperative until the switch is manually reset.
- 4.1.4.4.5 The governor switches and safety device mechanism switches shall conform to the following:
 - 4.1.4.4.5.1 Governor overspeed switches and speed-reducing switches required by item 4.1.4.4 shall be positively opened and shall remain in the open position until manually reset.
 - 4.1.4.4.5.2 Safety switches operated by the car safety device mechanism shall be positively opened and shall not reset unless the car safety device mechanism has been returned to the running position.
- 4.1.4.5 Governor Ropes
 - 4.1.4.5.1 Governor ropes shall be of iron, steel, Monel metal, phosphor bronze, or stainless steel, of reguler-lay construction, and shall be not less than 9.5 mm in diameter. Tiller-rope construction shall not be used.
 - 4.1.4.5.2 Whenever a governor rope is renewed, a running test of the safety device, with or without a load shall be conducted at not less than rated speed to demonstrate that the governor jaws or yoke properly grip the rope and that the safety device functions properly.
 - 4.1.4.5.3 Whenever wear, corrosion, broken wires, or other factors indicate that the governor ropes have its breaking strength reduced materially below the

manufacturer's rating, the rope shall be renewed. Governor ropes shall not be lengthened or repaired by splicing.

- 4.1.4.5.4 A metal, fiber, or plastic tag or tags shall be securely attached to each governor rope. This data shall bear the following wire rope data:
- The diameter in mm.
 - The manufacturer's rated breaking strength.
 - The grade of material used.
 - The month and year the ropes were installed and the safety devices tested. (The safety device test date may be indicated on a separate tag.).
 - Whether nonpreformed or preformed.
 - Construction classification.
 - Name of the person or firm that installed the ropes.
 - Name of the manufacturer of the rope.
- 4.1.4.5.5 During normal operation of the elevator, the governor rope shall run free and clear of the governor jaws, rope guards, and other stationary parts.
- 4.1.4.5.6 The governor rope shall be attached by an approved method such as babbitted sockets or crosby clips. The attachment shall develop a factor of safety of not less than 5 based on governor rope pull-through tension.
- 4.1.4.6 Design of Governor Rope-Grip Jaws for Type B Safety Devices
- 4.1.4.6.1 Type B car and counterweight safety devices shall be actuated by a governor equipped with rope-grip jaws which will permit the governor rope to pull through the jaws. The maximum tension in the governor rope to cause it to slip through the governor jaws shall not exceed 1/5 of the rated ultimate strength of the rope.
- 4.1.4.6.2 Governor jaws shall be of such shape and minimum length that no appreciable damage to or deformation of the rope shall result from the stopping action of the jaws in operating the car or counterweight safety device.
- 4.1.4.6.3 Each governor shall be equipped with a rope gripping device which does not depend solely on springs for the application of the jaws to the ropes. Springs may be used to provide the tension between the governor rope and the jaws as required to set the safety device.
- 4.1.4.7 Governor Marking Plate. A metal plate or plates shall be securely attached to each governor and shall be marked in a legible and permanent manner with letter and figures not less than 6 mm in height, indicating the following:
- The speed in m/min. at which the governor is set and sealed to trip.
 - The size, material, and construction of the governor rope in which the governor jaws were designed to operate.
 - The manufacturer and identifying number of the governor.
 - Pull-through tension settings of the governor jaws or governors used with Type B safety devices.

- 4.1.4.8 Emergency Terminal Stopping Devices. Emergency terminal stopping devices installed in connection with reduced-stroke oil buffers shall conform to the following:
 - 4.1.4.8.1 They shall operate at a predetermined distance from the terminal landing if the car has not slowed down to a predetermined speed when it reaches that predetermined distance from the terminal landing. The device shall automatically cause the power to be removed from the driving machine motor and brake independently of the normal stopping device.
 - 4.1.4.8.2 They shall provide a retardation not in excess of 9.8 m/sec.
 - 4.1.4.8.3 They shall not apply the car safety device.
 - 4.1.4.8.4 They shall be so designed and installed that a single short circuit caused by a combination of grounds or by other conditions shall not prevent their functioning.
 - 4.1.4.8.5 The car speed sensing device shall be located on the governor and the emergency terminal stopping switch shall be located in the hoistway except that the emergency terminal stopping switch may be located in the machine room provided the operating means conform to the following:
 - 4.1.4.8.5.1 They shall be operated by a device mechanically connected to and driven by the car. Friction or traction drives shall not be used.
 - 4.1.4.8.5.2 Tapes, chains, ropes, or similar devices used as the mechanical connection to the car shall be provided with an electrical contact which will cause the electric power to be removed from the elevator motor and brake if the mechanical connection fails.
- 4.1.5 Cabled Elevators
 - 4.1.5.1 Electrical Protective Devices. Electrical protective devices shall be provided in accordance with the following:
 - 4.1.5.1.1 Elevators having winding-drum machines shall be provided with a slack-rope device equipped with a slack-rope switch of the enclosed manually reset type which shall cause the electric power to be removed from the elevator driving-machine motor and brake if the hoisting ropes become slack.
 - 4.1.5.1.2 Where generator-field control is used, means shall be provided to prevent the application of power to the elevator driving-machine motor and brake unless the motor-generator-set connections are properly switched for the running condition of the elevator. It is not required that the electrical connections between the elevator driving-machine motor and the generator be opened in order to remove power from the elevator motor.
 - 4.1.5.1.3 Compensating-rope sheave shall be provided with a compensating-rope-sheave switch or switches, mechanically opened by the compensating-rope sheave, before the sheave reaches its upper or lower limit of travel, to cause the electric power to be removed from the elevator driving-machine motor and brake.
 - 4.1.5.1.4 Where generator-field control is used, a motor-field excitation switch shall be provided which shall cause the electric power to be removed from the elevator driving-machine motor and brake unless current is flowing in the shunt field circuit of the elevator driving-machine motor.

- 4.1.5.1.5 An emergency stop switch shall be provided in the car, and located in or adjacent to the car operating panel. When opened, this switch shall cause the electric power to be removed from the elevator driving-machine motor and brake independently of the operation of the operating device and the leveling device. Emergency stop switches shall:
- Be of the manually opened and closed type.
 - Have red operating handles or buttons.
 - Be conspicuously and permanently marked, "Stop".
 - Be positively opened mechanically and their opening shall not be solely dependent on springs.
- 4.1.6 Hydraulic Elevators
- 4.1.6.1 Electric Protective Devices. In addition to the normal terminal stopping devices, the following electrical protective devices shall be provided and shall conform to the requirements of item 4. 1. 5. 1, except that their operation shall cause the electrical power to be removed from all control valves and from the pump motor.
- 4.1.6.1.1 Emergency-stop switch.
- 4.1.6.1.2 Stop switches in pits.
- 4.1.6.1.3 Stop switches on top of cars.
4. 1.6.1.4 Hoistway door interlocks or hoistway gate contact locks.
- 4.1.6.1.5 Car-door or gate electric contacts.
- 4.1.6.1.6 Electric contacts for hinged car-platform sills except that devices in items, 4.1.6.1.3, 4.1.6.1.4 and 4.1.6.1.5 need not remove the power within the leveling zones.
- 4.1.7 Emergency Signal Devices
- 4.1.7.1 Emergency Devices for Summoning Assistance
- 4.1.7.1.1 Passenger elevators and automatic operation freight elevators shall be provided with an emergency alarm system, operable from within the car, which will provide effective means for summoning assistance at all hours in case of emergency.
- 4.1.7.1.2 New installations of passenger or freight elevators, which are operated at any time without a designated operator in the car, shall be provided with one of the two following emergency alarm systems.
- 4.1.7.1.2.1 A telephone in each elevator car, connected to a central telephone exchange providing 24 hour service.
- 4.1.7.1.2.2 A system meeting the following requirements:
- 4.1.7.1.2.2.1 An electric bell, operable from the car, not less than 15 cm in diameter, located inside the building and audible inside and outside the hoistway. One bell operable from all cars may be used for a group of elevators.
- 4.1.7.1.2.2.2 Means for 2-way conversation between each elevator and a readily accessible point outside the hoistway except that elevators in buildings having a height

from the lowest to the highest elevator landing of not more than 20 m, providing the distance between any adjacent landing does not exceed 4.6 m. When the means of communication with an approved emergency service permits 2-way conversation. See item 4.1.7.1.2.2.3.2.

- 4.1.7.1.2.2.3 Where elevators, which are operated at any time without a designated operator in the car, are located in building, where attendants, watchmen, or tenants are not continuously available to take action in case of emergency signal is operated, and are not provided with a telephone in the elevator car connected to a central exchange system they shall be provided with one of the following additional emergency signal devices:
 - 4.1.7.1.2.2.3.1 An electrical alarm bell, not less than 15 cm in diameter operable from inside the car shall be mounted in a weatherproof enclosure on the outside of the building near the main entrance. A sign that can be read from the adjacent sidewalk shall be mounted on or near the bell and shall be, marked "Elevator Emergency, Call Police" in letters not less than 50 mm high. Only one outside alarm bell is required, which shall be operable from the cars of all elevators of the type specified in the building. An emergency power source meeting the requirements of item 4.1.7.1.2.2.3 shall be provided.
 - 4.1.7.1.2.2.3.2 Means within the car for communicating with or signaling to an approved emergency service which operates 24 hours each day.
- 4.1.7.1.3 A sign, having lettering not less than 6 mm shall be provided in passenger elevators adjacent to the car emergency alarm giving instruction as to the use of the device for summoning assistance.
- 4.1.7.2 Photoelectric Tube Bypass Switch
 - 4.1.7.2.1 Elevators equipped with photoelectric tube devices, which control the closing of automatic, power-operated car or hoistway doors, or both, shall have a switch in the car which, when actuated, will render the photoelectric tube device ineffective.
 - 4.1.7.2.2 The switch shall be constant-pressure type, requiring not less than 4.5 kg nor more than 6.8kg pressure to actuate.
 - 4.1.7.2.3 The switch shall be located not less than 1.8 m nor more than 2 m above the car floor, and shall be located in or adjacent to the operating panel.
 - 4.1.7.2.4 The switch shall be clearly labeled "To Be Used In Case of Fire Only".
- 4.-1.7.3 Operation of Elevators Under Fire or Other Emergency Conditions
 - 4.1.7.3.1 Elevators with automatic operation and automatic power operated hoistway doors shall conform to the following with the exception of elevators having a travel of not more than 7.6 m:
 - 4.1.7.3.1.1 A 3-position (on, off and bypass) key-operated switch shall be provided at the main floor for each single elevator or for each group of elevators. The key shall be removable only in the "On" and "Off" positions. When the switch is in the "On" position, all elevators controlled by this switch and which are on automatic service shall return nonstop to the main floor and the doors shall open and remain open.

- 4.1.7.3.1.1.1 An elevator traveling away from the main floor shall reverse at the next available floor without opening its doors.
- 4.1.7.3.1.1.2 Elevators standing at a floor other than the main floor, with doors open, shall close the doors without delay, and proceed to the main floor.
- 4.1.7.3.1.1.3 Door reopening devices for power-operated doors which are sensitive to products of combustion, heat or flame shall be rendered inoperative.
- 4.1.7.3.1.1.4 All car and corridor call buttons shall be rendered inoperative and all call registered lights and direction lanterns shall be extinguished and remain inoperative.
- 4.1.7.3.1.1.5 A car stopped at a landing shall have its "Emergency Stop Switch" required by item 4.1.5.1.5 rendered inoperative as soon as the doors are closed and it starts toward the main floor. A moving car, traveling to or away from the main floor, shall have its "Emergency Stop Switch" rendered inoperative immediately.
- 4.1.7.3.1.1.6 A sensing device at each elevator landing which when activated prevents cars from stopping at that floor shall not be substituted for the above requirements.
- 4.1.7.3.1.2 Sensing Devices. In addition to the key operated switch required in item 4.1.7.3. 1.1 above, sensing devices shall be installed at each elevator landing at each floor except the main floor. The sensing devices shall be either combined rate of rise and fixed temperature devices or smoke sensing devices. The activation of a sensing device at any elevator landing shall cause all cars in all groups that serve that landing to return non-stop to be main floor. The operation shall conform to the requirements of items 4.1.7.3.1.1.1 through 4.1.7.3.1.1.5. The key-operated switch required by item 4.1.7.3.1.1 when moved to the "bypass" position, shall restore normal service independent of the sensing devices with the following exceptions:
 - 4.1.7.3.1.2.1 Elevator landings in buildings which are completely protected by an automatic sprinkler system.
 - 4.1.7.3.1.2.2 Elevator landings of unenclosed landings open to the atmosphere or open to an interior court of a building.
 - 4.1.7.3.1.2.3 Freight elevators located in single use buildings where openings are into manufacturing areas.
- 4.1.7.3.1.3 Elevators without a landing at grade level shall be returned to that landing closest to grade level or other level approved by the local fire authorities and shall conform to the requirements of items 4.1.7.3.1.1.1 through 4.1.7.3.1.1.6.
- 4.1.7.3.1.4 Elevators having a travel of 21 m or more above the lowest grade elevation surrounding the building shall be provided with the following operation:

A 2-position (off, on) key-operated switch shall be provided in or adjacent to an operating panel in each car and shall be effective only when the main floor-key operated switch is in the "On" position or a sensing device has been activated and the car has returned to the main floor or other approved level. The key shall be removable only in the "Off" position and when in the "On" position it shall place the elevator on emergency service.

The operation of elevators on emergency service shall be as follows:

- 4.1.7.3.1.4.1 An elevator shall be operable only by a person in the elevator.
- 4.1.7.3.1.4.2 Elevators shall not respond to elevator corridor calls.
- 4.1.7.3.1.4.3 The opening of power-operated doors shall be controlled only by continuous pressure "door Open" buttons or switches. If the switch or button is released prior to the doors reaching the fully open position, the doors shall automatically close. Open doors shall be closed by registration of a car call or by pressure on "door Close" switch or button.
- 4.1.7.3.1.4.4 The car shall stay on emergency service as long as the car key is in the "On" position even though, the main floor key-operated switch is returned to its "Off" position.
- 4.1.7.3.1.4.5 The emergency stop switch shall be rendered operative.
- 4.1.7.3.1.5 The switches required by items 4.1.7.3.1 and 4.1.7.3.4 shall be operated by the same key but shall not be a part of a building master key system. There shall be a key for the main floor switch and for each elevator in the group and these keys shall be kept on the premises by persons responsible for maintenance and operation of the elevators, in a location approved by the local fire protection authorities readily accessible to authorized persons, but not where they are available to the public. The locks shall be of the cylinder type having not less than a 5-pin or 5-disc combination.
- 4.1.7.3.2 Elevator operable only by a designated attendant in the car shall be provided with a signal system consisting of both visual and audible type actuated at the main floor or other approved level, to alert the attendant to return non-stop to the main floor or other approved level. Provisions shall be made to alert the attendant in the same manner when a sensing device is activated.
- 4.1.7.3.3 Elevators arranged for dual operation shall when on automatic operation conform to item 4.1.7.3.1 and when on operation by a designated attendant in the car, conform to item 4.1.7.3.2.
- 4.1.7.3.4 Instruction for operation of elevators under fire and other emergency conditions shall be incorporated within the enclosure for the switch at the main floor required by items 4.1.7.3.1 and 4.1.7.3.2 or shall be posted adjacent to it. Instructions shall be in letters not less than 6 mm in height and shall be permanently installed and protected against removal and defacement.
- 4.1.7.3.5 Elevator hoistways shall have a floor number not less than 100 mm in height, placed on the walls and/or doors of the hoistway at intervals such that a person in a stalled elevator, upon opening the car door, can determine the floor position.
- 4.1.7.3.6 All automatic elevators shall have not less than one sign at each landing printed on a contrasting background in letters not less than 13 mm high to read: "In case of fire use stairway for exit. Do not use elevator".
- 4.1.8 Permit to Operate
- 4.1.8.1 Submittal of Plans and Notification of Intent to Install
- 4.1.8.1.1 The person or firm who intends to install a new elevator shall submit the erection plans to the concerned authorities for review. In lieu of complete

erection drawings and plans, the concerned authorities will accept notification from a recognized elevator company that they intend to install a device covered by the concerned authority regulations of a certain type at a definite address, and subsequent notification to the concerned authorities that the installation is complete and ready for inspection.

- 4.1.8.1.2 Concerned authorities may require drawings and details of construction of any portion of an installation when complete erection plans are not submitted.
- 4.1.8.1.3 When an installation required material, fabrication and construction other than recognized standard types, installed in other than a fully enclosed hoistway, drawings and details shall be submitted to the concerned authorities prior to installation.
- 4.1.8.1.4 Major alterations to existing passenger or freight elevators as defined in item 3 shall be considered as new installations for submittal of plans or notice of intent to make the alteration and the subsequent notification that the work is complete and ready for inspection.
- 4.1.8.1.5 The person or firm doing the work of replacing door locking devices, safety devices, governors, or oil buffers on existing installation of passenger or freight elevators shall notify the concerned authorities when the work is complete and ready for inspection.
- 4.1.8.1.6 The person or firm responsible for special maintenance operations such as the cleaning of glass or the replacement of lamps that cannot be performed from inside the elevator car, shall submit a plan to the concerned authorities outlining a safe method that will be used to perform the maintenance.
- 4.1.8.2 Inspections Required
 - 4.1.8.2.1 Each new device shall be inspected by an authorized representative of the concerned authorities and a permit to operate issued before the device is placed in service.
 - 4.1.8.2.2 Each major alteration of all existing passenger or freight elevator shall be inspected by an authorized representative of the concerned authorities and a new permit to operate issued before the elevator is placed back in service.

Exception: After the inspection of a new device or a major alteration, the device may be placed in service while the permit to operate is being processed, provided, in the opinion of the inspecting representative of the concerned authorities, the device is safe to operate.
 - 4.1.8.2.3 The replacement of door locking devices, safety devices, governors, or oil buffers shall be inspected by an authorized representative of the concerned authorities.
- 4.1.8.3 Permit to Operate Required. After the inspection and the completion of such requirements as may be necessary in the opinion of the concerned authorities to comply with the concerned authority regulations, a permit to operate will be issued. The permit to operate a passenger or freight elevator shall be posted in the elevator car. For other devices, the permit shall be available on the premises.

- 4.1.8.4 Frequency of Inspection. Certificates will be automatically suspended if, for a period of one year, an inspector does not make any elevator inspections as evidenced by reports submitted; however, such certificates may be reinstated at the discretion of the concerned authorities.
- This provision does not apply to the supervising engineers or others whose regular duties include the review of the work of other certified inspectors.
- 4.1.9 Personnel Hoists
- 4.1.9.1 Hoist towers outside the structure shall be enclosed for the full height on the side or sides used for entrance and exit to the structure. At the lowest landing, the enclosure on the sides not used for exit or entrance to the structure shall be enclosed to a height of at least 3 m. Other sides of the tower adjacent to floors or scaffold platforms shall be enclosed to a height of 3 m above the level of such floors or scaffolds.
- 4.1.9.2 Towers inside of structures shall be enclosed on all four sides throughout the full height.
- 4.1.9.3 Towers shall be anchored to the structure at intervals not exceeding 7.6 m. In addition to tie-ins, a series of guys shall be installed. Where tie-ins are not practical the tower shall be anchored by means of guys made of wire rope at least 12.7 mm in diameter, securely fastened to anchorage to ensure stability.
- 4.1.9.4 Hoistway doors or gates shall be not less than 2 m high and shall be provided with mechanical locks which cannot be operated from the landing side, and shall be accessible only to persons on the car.
- 4.1.9.5 Cars shall be permanently enclosed on all sides and the top, except sides used for entrance and exit which have car gates or doors.
- 4.1.9.6 A door or gate shall be provided at each entrance to the car which shall protect the full width and height of the car entrance opening.
- 4.1.9.7 Overhead protective covering of 50 mm planking, 19 mm plywood or other solid material of equivalent strength shall be provided on the top of every personnel hoist.
- 4.1.9.8 Doors or gates shall be provided with electric contacts which do not allow movement of the hoist when door or gate is open.
- 4.1.9.9 Safeties shall be capable of stopping and holding the car and rated load when traveling at governor tripping speed.
- 4.1.9.10 Cars shall be provided with a capacity and data plate secured in a conspicuous place on the car or crosshead.
- 4.1.9.11 Internal combustion engines shall not be permitted for direct drive.
- 4.1.9.12 Normal and final terminal stopping devices shall be provided.
- 4.1.9.13 An emergency stop switch shall be provided in the car and marked "Stop".
- 4.1.9.14 Ropes
- 4.1.9.14.1 The minimum number of hoisting ropes used shall be 3 for traction hoists and 2 for drum-type hoists.

- 4.1.9.14.2 The minimum diameter of hoisting and counterweight wire ropes shall be 13 mm.
- 4.1.9.14.3 Safety factors:

Minimum Factors of Safety for Suspension Wire Ropes

Rope Speed	Minimum Factor of Safety
15	7.60
23	7.75
30	7.95
39	8.10
46	8.25
53	8.40
60	8.60
68	8.75
76	8.90
90	9.20
106	9.50
120	9.75
137	10.00
150	10.25
168	10.45
180	10.70

- 4.1.9.15 Following assembly and erection of hoists, and before being put in service, an inspection and test of all functions and safety devices shall be made under the supervision of a competent person. A similar inspection and test is required following major alteration of an existing installation. All hoists shall be inspected and tested at not more than 3-month intervals. Records shall be maintained and kept on file for the duration of the job.
- 4.1.9.16 Personnel hoists used in bridge tower construction shall be approved by a professional engineer and erected under the supervision of a qualified engineer competent in this field.
- 4.1.9.17 When a hoist tower is not enclosed, the hoist platform or car shall be totally enclosed (caged) on all sides for the full height between the floor and the overhead protective covering with 19.05 mm mesh of 1.9 mm wire or equivalent. The hoist platform enclosure shall include the required gates for loading and unloading.
- 4.1.9.18 These hoists shall be inspected and maintained on a weekly basis. When ever the hoisting equipment is exposed to winds exceeding 56 km/hr it shall be inspected and put in operable condition before reuse.
- 4.1.9.19 Wire rope shall be taken out of service when any of the following conditions exist:

- 4.1.9.19.1 In running ropes, 6 randomly distributed broken wires in 1 lay or 3 broken wires in 1 strand in 1 lay;
- 4.1.9.19.2 Wear one-third the original diameter of outside individual wires. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure;
- 4.1.9.19.3 Evidence of any heat damage from any cause;
- 4.1.9.19.4 Reductions from nominal diameter of more than 1.19 mm for diameters to and including 19.05 mm, 1.59 mm for diameters 22.23 mm to 28.57 mm inclusive, 2.38 mm for diameters 31.75 to 38.1 inclusive;
- 4.1.9.19.5 In standing ropes, more than 2 broken wires in 1 lay in sections beyond end connections or more than 1 broken wire at an end connection.